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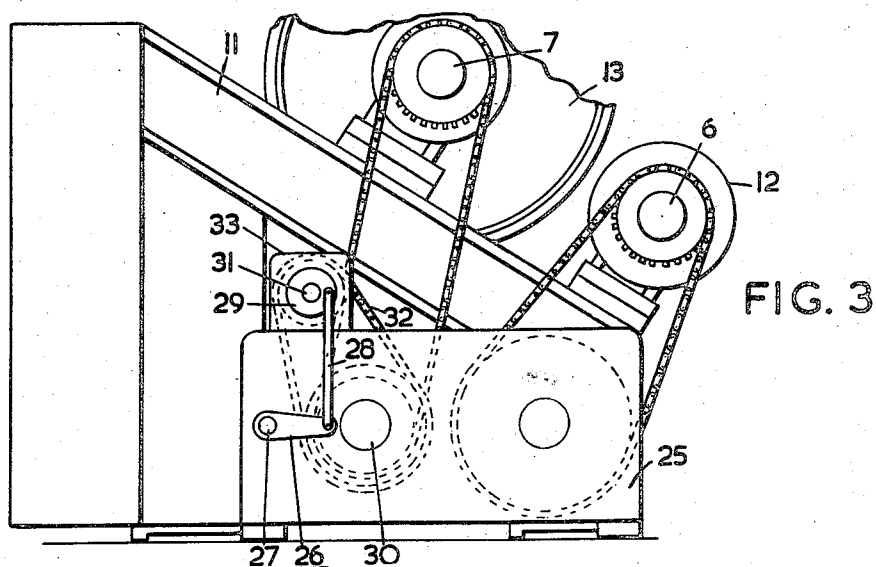
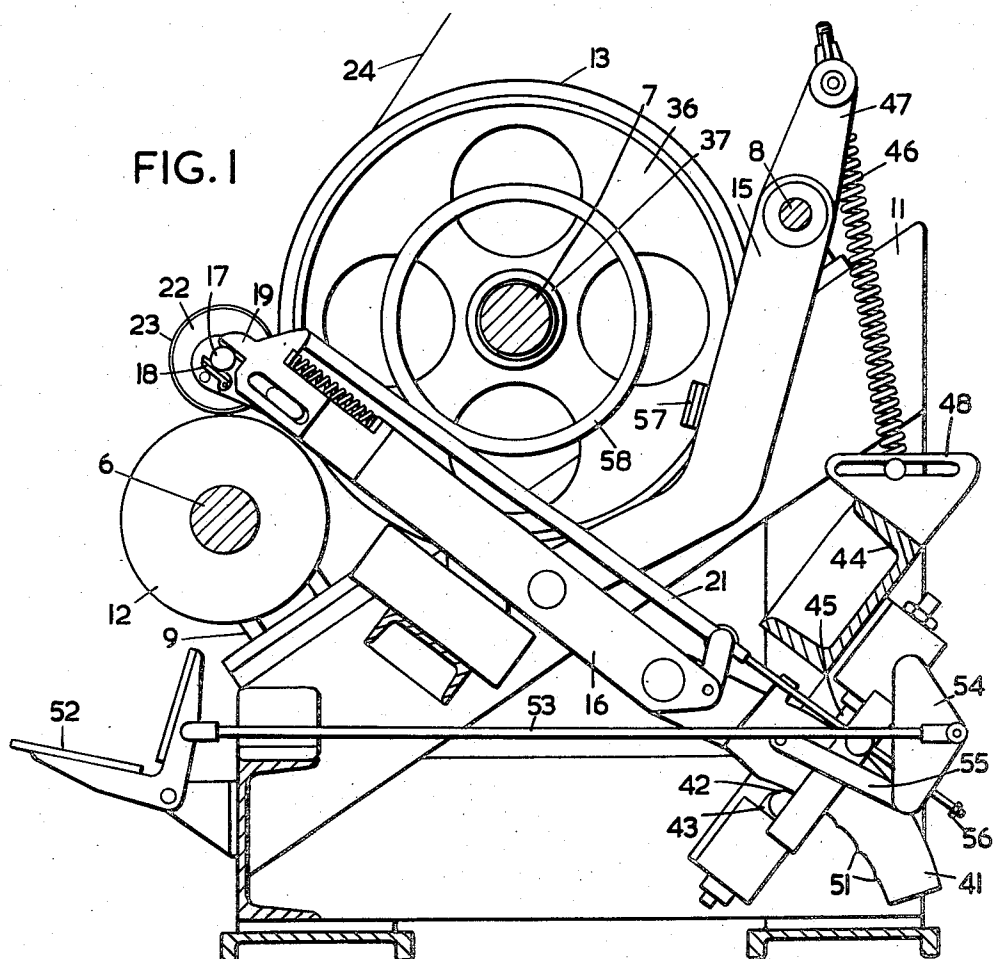
W. POOL ET AL

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YARN WINDING WITH MEANS TO PREVENT RIBBON WIND

Filed March 29, 1956

2 Sheets-Sheet 1



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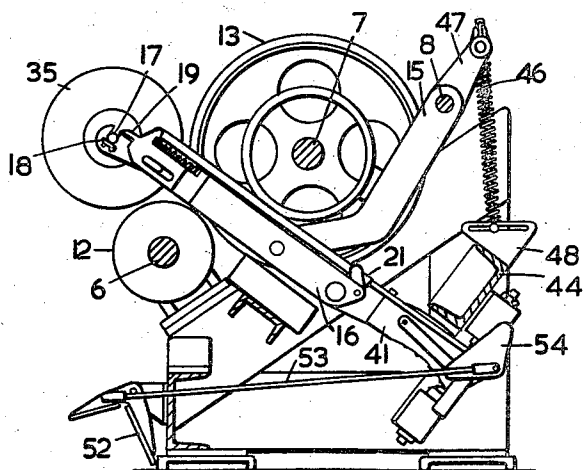
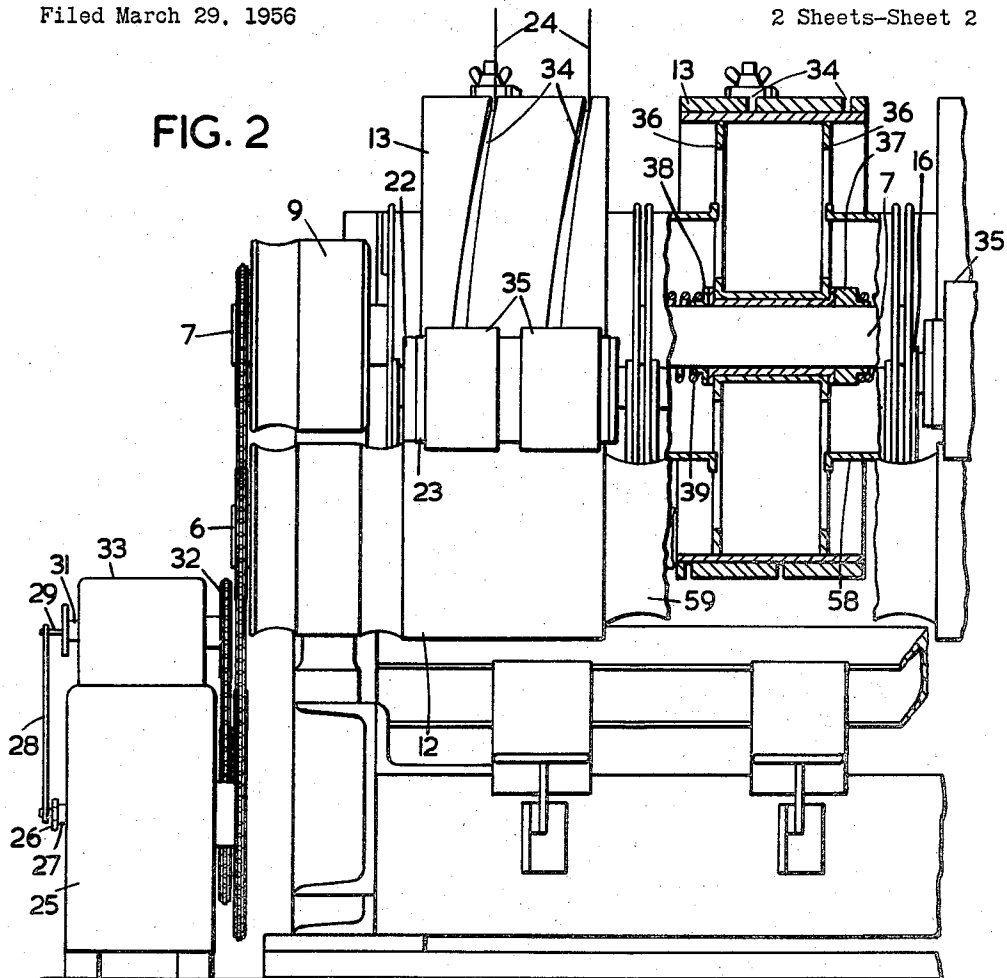
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2 Sheets-Sheet 2



1

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YARN WINDING WITH MEANS TO PREVENT RIBBON WIND

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This invention relates to yarn winding, and particularly to the winding of yarn into packages on machines of the type in which the yarn is traversed to-and-fro along the length of the package being wound by means of a grooved or slotted rotating traverse drum.

According to the present invention, in the winding of yarns on machines of the kind referred to, the package is maintained in surface contact with the traverse drum while said drum is driven at the same surface speed as said package during part of the winding of the package, but is maintained out of contact with said drum at periods when "ribboning" is liable to occur, i. e. when the circumference of the drum bears a simple numerical relationship to the circumference of the package, the drum being driven during such periods at a speed fluctuating in relation to that of said package so as to avoid such ribboning. In this way, while ribboning is avoided, the advantages of contact between package and drum is secured at other periods, the principal advantage being the close control of the traversing of the yarn right up to the surface of the package, especially at the ends of the traverse, and the building of a compact square-ended package. When the package is out of contact with the traverse drum there is a tendency for the actual length of traverse of the yarn on the package to diminish. This feature has its own advantages at periods when ribboning is liable to occur since at such periods, even if ribboning is avoided by a fluctuating traverse speed, the tendency to ribbon gives the package a slight tendency to spread which counteracts the tendency of the package length to diminish when the traverse drum is spaced from the package. Thus the optimum conditions can be brought about throughout the growth of the package selectively according to whether ribboning is liable to occur or not.

It is generally desirable, and sometimes essential, that the package should be driven with a uniform surface speed throughout the winding method so as to take-up the yarn at a constant linear rate. This is particularly important when winding artificial continuous filament yarns continuously with their production. The uniform surface speed of the package can be brought about by driving it, throughout the winding operation, by surface contact with a driving drum separate from the traverse drum. When the package is in surface contact with the traverse drum, as well as with the driving drum, the traverse drum is driven at the same peripheral speed as the package, e. g. by said surface contact. The fluctuating speed of the traverse drum when out of contact with the package can be effected by mounting the drum on a shaft, driven at a fluctuating speed and connected to the drum by a light friction drive. The light friction drive is caused to slip while the traverse drum is in contact with, and is driven by, the package but can control the speed of the traverse drum when the latter is out of contact with the package. The shaft can be driven from the constantly acting traverse roll, or from the same source of power, at a peripheral speed having an average value equal to that of the driving drum and the package. It can be

2

caused to fluctuate above and below the average speed by the interposition in the drive to its shaft of an anti-ribboning gear of known type, adapted to impose an alternate increment and decrement on the output speed. The driving of the shaft at a fluctuating speed throughout the winding operation is particularly convenient in multi-spindle machines wherein the spindles are required to wind independently and to start and complete their packages at different times. In such case, the different packages will reach the stages where ribboning is liable to occur at different times, but since the speed of the traverse drum shaft common to all the spindle units of the machine is varied continuously it is able to deal with a tendency to ribboning as it arises, on each spindle independently.

The maintaining of the package in or out of contact with the traverse drum at different speeds according to the diameter of the package can be effected by suitably constraining the path followed by the package axis as it moves during the growth of the package. Thus, a mounting may be provided for the package support, adapted to permit the package to make surface contact with the traverse drum but moved, by means associated with said mounting, to bring the package out of contact with said traverse drum at the desired periods. In one convenient arrangement the package can be carried on a freely rotatable spindle, mounted parallel to the shafts of the driving drum and the traverse drum and carried at one end of a mounting lever which in turn is pivoted at a point along its length to one end of a lever extending up and down and capable of swinging about its other end. The other end of the mounting lever can then be furnished with a cam or profile plate adapted to engage a cam follower in the form of a small roller rotatable on a fixed axis. The package is urged towards the nip between the traverse drum and the driving drum, and the engagement of the cam or profile plate with the stationary roller determines, in conjunction with the size of the package, whether the package is permitted, under such loading, to engage both rollers or the driving roller only. As the package grows and the upwardly extending lever swings about its pivot, the rear end of the generally horizontal lever draws the cam plate past the fixed roller, and the cam plate can be shaped so as to allow the package to maintain contact with the traverse drum over certain periods of the driving of the package while constraining it to move out of contact with the traverse drum at the other selected periods.

Instead of attaching the profile cam to the package mounting, it may be attached to the machine frame and engaged by a roller carried by the package mounting. Again, instead of constraining the package out of contact with the traverse drum, the cam (whether carried by the package mounting or by the machine frame) can be arranged to force the package into contact with the traverse drum, the package being otherwise maintained in contact with the driving drum only by the combined effect of its own weight and suitable spring- or weight-loading applied to its mounting. The spring- or weight-loading can be arranged to vary in the course of the winding operation so as to give a steady, or only slightly increasing pressure between the package and the driving roller, notwithstanding the substantial increase in weight of the package.

The invention is of particular advantage as allowing packages to be built of very substantial diameter and weight; the package can grow in diameter to a degree which allows it to pass several times through phases in which ribboning would be liable to occur if the traverse drum were driven always at the same peripheral speed as the package, so that a condition which commonly limits the diameter of packages wound by means of a

traverse drum is removed. For the same reason, and also because of the possibility of a constant linear take-up speed for the yarn, the invention is particularly suitable (as mentioned above) for the take-up of artificial continuous filament yarn continuously with its production, especially when the yarn is produced at a high linear speed as in the dry-spinning of yarns of cellulose acetate or other organic derivative of cellulose, or the melt-spinning of yarns of synthetic linear polymeric materials, e.g. polyamides such as polyhexamethylene adipamide, polyamino acids such as poliamino caproic acid, and polyesters such as polyethylene terephthalate. Any convenient type of grooved or slotted traverse drum can be employed for the purpose of the present invention: a particularly convenient form of drum is that described in U.S.A. application S. No. 574,744, filed March 29, 1956, whether constructed for the winding of a single cheese or provided with two (or more) spaced grooves for the winding of two (or more) separate cheeses side by side on the same package-support tube.

By way of example, one form of yarn-winding apparatus in accordance with the present invention will now be described in greater detail with reference to the accompanying drawings in which,

Figure 1 is a sectional side elevation of the machine,

Figure 2 is as a front elevation of a portion of the machine partly broken away to show details,

Figure 3 is a detail view of the traverse shaft drive, and

Figure 4 shows a portion of Figure 1 in the disengaged position of the yarn package.

Referring to Figures 1 and 2 the machine shown therein is a multi-spindle machine and comprises three shafts 6, 7 and 8 extending along the length of the machine and carried in bearings 9 in the end frames 11 of the machine. The bottom shaft 6, nearest the front of the machine, carries a series of driving drums 12, the middle shaft 7, a series of traverse drums 13, while the upper shaft 8 serves as a pivot about which swing a series of depending double levers 15. Pivoted at about their mid-points on the lower ends of the leaves 15 are a series of double levers 16 adapted to carry package spindles 17 at their forward ends. The spindles 17 are stationary but detachable spindles, gripped at each end between a pair of jaws 18, 19, the jaw 18 being fixed on the lever 16 while the jaw 19 is slidably mounted thereon under the control of a rod 21 extending the length of the lever 16 and operated as described hereafter. Rotatable on ball bearings on the spindle 17 is a carrier 22 adapted to receive and grip a cheese tube 23. Both parts of the double lever 16 are provided with jaws 18, 19, so as to grip both ends of the spindle 17.

The shaft 6 is driven at a constant speed such as to give the driving drums 12 mounted thereon a peripheral speed equal to the desired linear speed of winding of the yarn, indicated at 24. The shaft 7 is driven through an infinitely variable gear box 25 (Figures 2 and 3) at an average speed which is about half that of the shaft 6, the diameter of the traverse drums 13 being about twice the diameter of the driving drums 12 so that their average peripheral speed when driven by the shaft 7 is equal to that of the drums 12. The speed variation is effected by oscillating a lever 26 on the control shaft 27 of the gear box 25, the lever 26 being connected by a rod 28, crank 29 mounted on a crank shaft 31 which is driven by a chain and sprocket 32 and a reduction gear 33, from the shaft 30. A speed fluctuation of the order of 10% is suitable for the purpose.

The traverse drums 13 are each formed with two yarn-guiding grooves 34 (Figure 2) for traversing two yarns 24 so as to form two cheeses 35 spaced side by side on the cheese tube 23. The drums 13 are mounted on hubs 36 which are held on the shaft 7 between a collar 37 fixed to the shaft 7 and a collar 38 springloaded by

means of a spring 39 towards the collar 37 so as to nip the hub 36 frictionally between the collars 37, 38. The spring 39 is supported at its other end from collar 37 of the adjoining drum 13.

The rear end of the double lever 16 carries a suitably shaped profile plate or cam 41 the lower edge of which engages above the freely rotatable roller 42 mounted on a bracket 43 fixed to the machine frame member 44. A spring-loaded plunger 45 also carried by the bracket 43, acts on the upper edge of the profile plate 41 and holds it in engagement with the roller 42. As the packages 35 grow on the package support 23, the double lever 16 and the depending double lever 15 are drawn forward, assisted by a tension spring 46 connected between an upward extension 47 of the lever 15 and a bracket 48 mounted on the frame member 44 which also carries the bracket 43. The bracket 48 is slotted for the adjustment of the lower end of the spring 46. As the lever 16 moves forward the profile plate 41 is drawn forward over the fixed roller 42. The general outline of the profile plate 41 is such that, with the packages 35 in contact with both drums 12, 13, it just touches the fixed roller 42. This general outline, however is augmented by shallow rises 51 occurring at intervals along the profile of the shaped edge of the plate 41 corresponding to various diameters of the growing packages 35. These diameters are those which are sub-multiples or simple fractions (e. g. $\frac{2}{3}$ or $\frac{3}{4}$) of the diameter of the traverse drum 13. At these rises the rear end of the lever 16 is lifted so as to force the packages 35 downward and forward over the driving drum 12 and out of engagement with the traverse drum 13.

In the operation of the machine, the levers 15, 16 are first swung forward by means of a foot pedal 52 connected by a rod 53 to a lever 54 pivoted on the bracket 43 and connected in turn by a link 55 to the profile plate 41 at the rear end of the lever 16. The rear end of the control rod 21 extends through the bracket 43 and is provided with an end stop 56 which engages the bracket so that the rod 21 and the movable jaw 19 are drawn back relatively to the lever 16. This releases the spindle 17 from the jaws 18, 19, whereupon the spindle is removed and replaced by a fresh spindle carrying an empty cheese tube 23. The lever 15 carries a brake pad 57 which engages with a brake drum 58 secured to the traverse drum 13, so bringing it to rest on the rotating shaft 7. The yarns 24 to be wound are led down between the traverse drum 13 and the new package support 23, being collected temporarily on a waste roller 59 disposed between one driving drum 12 and the next. The pedal 52 is then released and the levers 15, 16 swing back against the action of the spring 46, until the cheese tube 23 makes contact with both the driving drum 12 and the traverse drum 13. At the same time the yarn is engaged with the cheese tube 23 so as to be wound thereon, and is broken off between the cheese tube and the waste roller 59. In this position the profile plate 41 is just in contact with its roller 42 and does not hinder the contact of the empty package support 23 with the traverse drum 13.

The driving roller 12 then drives the package support 23 which in turn determines the speed of the traverse drum 13. However, the traverse drum 13, having been released by the removal of the brake pad 57 from the brake drum 58, is already rotating at a speed approximately equal to that of the driving drum 12.

Winding then proceeds, the yarns 24 being traversed to-and-fro along the length of the cheese tube 23 and being closely controlled right up to the surface of the package by the fact that the package is in actual contact with the traverse drum. The diameter of the empty package support 23 is selected so as not to be a sub-multiple of the diameter of the traverse drum 13, so that a tendency to ribboning during the initial stage of winding is avoided. As the packages 35 grow, however,

5

their diameter reaches a value which is a sub-multiple of the diameter of the traverse drum 13. Up to this point the profile of the cam plate 41 is such as to allow the contact of the packages 35 with the traverse drum 13 as well as with the driving drum 12. At, or just before this point, however, a rise 51 in the profile of the cam 41 lifts the rearward end of the lever 16 and causes its forward end (carrying the package 35) to move downwards and forward so that the package 35 is brought out of contact with the traverse drum 13 while still maintained by its own weight and that of the levers 15, 16, in contact with the driving drum 12. The traverse drum 13 is then driven by the light frictional connection 37, 38, 39 with its own shaft 7 instead of being driven by contact with the packages 35. The fluctuating speed of the shaft 7 prevents the traverse drum 13 being driven, for any substantial period, at a speed which is equal to the peripheral speed of the packages 35 and so prevents the occurrence of ribboning. When the packages 35 have further grown so that their diameter is no longer a sub-multiple of the diameter of the traverse drum 13, the forward movement of the packages 35 and spindle 17 draws the profile cam 41 forward, so that the previously operative rise 51 passes the fixed roller 42 and allows the package 35 to return into contact with the traverse drum 13. Winding then proceeds until the package size reaches another sub-multiple of the traverse drum size, when a further rise 51 in the profile cam 41 causes the actions described above to be repeated. Winding then continues with the packages alternately in and out of contact with the traverse drum until the packages are completed. The packages are then swung out of contact with both drums 12, 13 by means of the pedal 52, the packages 35 on the cheese tube 23 are removed with their spindle 17 and replaced by a fresh spindle carrying an empty package support 23. The cycle is then repeated.

Having described our invention, what we desire to secure by Letters Patent is:

1. A method of winding yarns comprising feeding a yarn to a rotating package support, traversing the yarn to-and-fro along the length of said support by means of a grooved or slotted rotating traverse drum, maintaining said package in surface contact with said traverse drum while driving said drum at the same surface speed as said package during part of the winding of the package, maintaining said package out of contact with said drum at periods when the circumference of said drum bears a simple numerical relationship to the circumference of said package, and driving said drum during said periods at a speed fluctuating in relation to that of said package.

2. Method according to claim 1 comprising driving the package with a uniform surface speed throughout the winding thereof.

3. Method according to claim 1 comprising driving the traverse drum, when in surface contact with the package, by said surface contact.

6

4. Method according to claim 3 comprising driving the traverse drum by frictional engagement with a shaft driven at a fluctuating speed, and causing said engagement to slip when said drum is in contact with the package.

5. Method according to claim 4 for winding a plurality of yarns into packages, said method comprising driving a plurality of traverse drums by frictional engagement with a common shaft and moving the packages into and out of engagement with said drums independently of one another.

6. Apparatus for winding yarns, said apparatus comprising means for rotating a package support to wind a yarn into a package thereon, a grooved or slotted traverse drum adapted, on rotation, to traverse said yarn to-and-fro along the length of said package support, a mounting for said package support adapted to permit said package to make surface contact with said traverse drum, means associated with said mounting for moving said package out of contact with said traverse drum at periods when the circumference of said drum bears a simple numerical relationship to the circumference of said package and means for driving said traverse drum with a fluctuating speed when said package is out of contact therewith.

7. Apparatus according to claim 6 comprising means for rotating the package with a uniform peripheral speed.

8. Apparatus according to claim 7 comprising a driving drum, additional to the traverse drum and adapted to drive the package by surface contact therewith.

9. Apparatus according to claim 8 comprising a cam and a cam-follower, one fixed to the package support mounting and the other to the machine frame, and adapted to move relatively to and in engagement with one another as the package grows, said cam being adapted to control the position of the package in relation to the traverse drum.

10. Apparatus according to claim 9 wherein the cam is secured to the mounting.

11. Apparatus according to claim 7 wherein the traverse drum is free to be rotated by surface contact with the package.

12. Apparatus according to claim 11 comprising a supporting shaft for the traverse drum, means for driving said shaft at a fluctuating speed, and a slipping friction clutch between said shaft and said traverse drum.

13. Apparatus according to claim 12 for the winding of a plurality of yarns, said apparatus comprising a plurality of traverse drums mounted on a common supporting shaft, and means independent of one another for controlling the relationship of a plurality of packages with said traverse drums.

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